

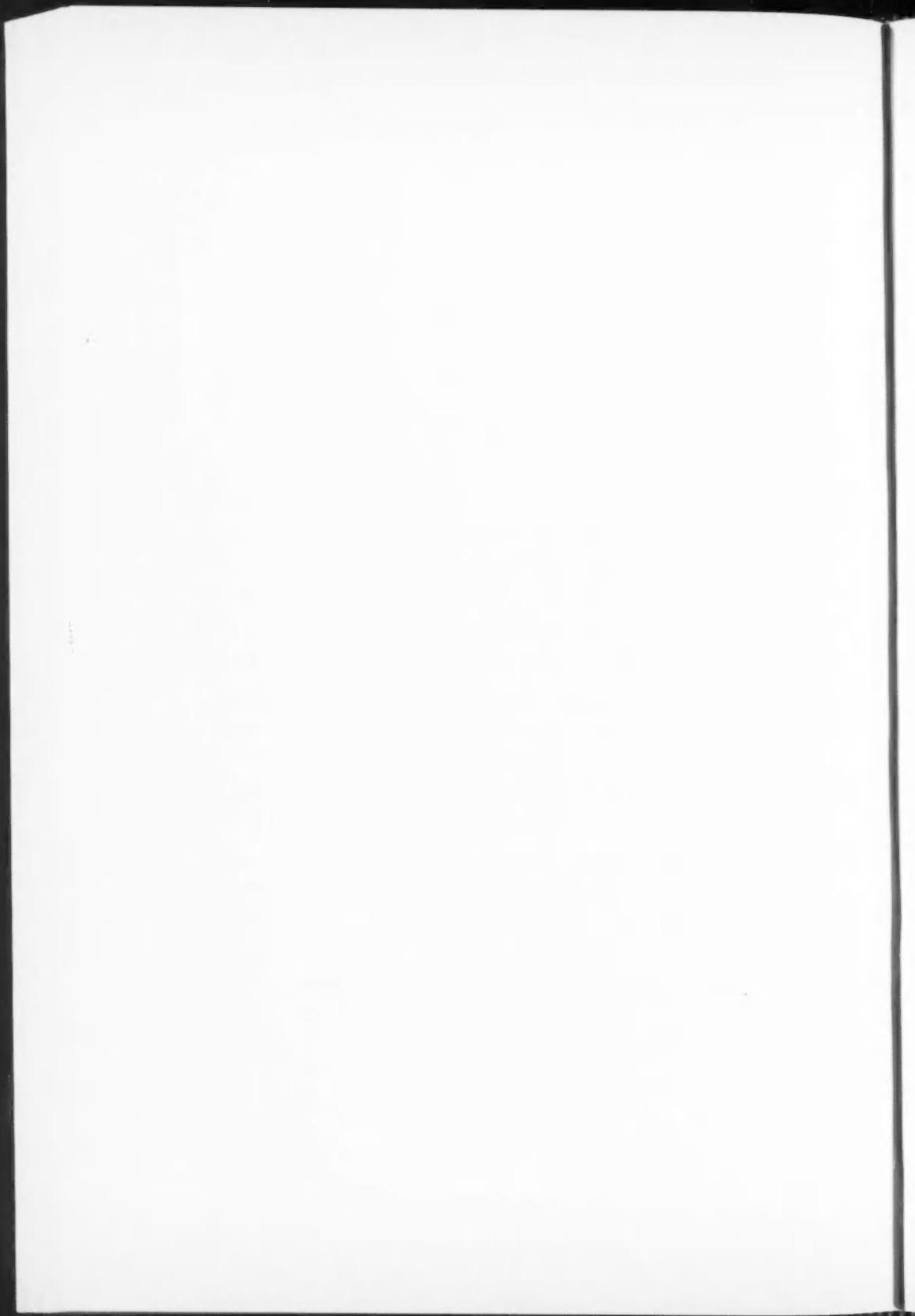
D_EGENERATIVE DISEASES

by

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DEGENERATIVE DISEASES

MASS INOCULATION of children with the new Salk vaccine—once the difficulties met at the outset have been resolved—promises to add poliomyelitis to the long list of dread diseases that have yielded to discoveries of medical research. Like smallpox, diphtheria, typhoid and other once-prevalent afflictions now virtually eradicated in the United States, polio is an infectious disease caused by an invasion of the body by a virulent organism. Such diseases have been overcome to a large extent by the development of serums or vaccines which, when introduced into the human system, stimulate the production of antibodies that stand ready to destroy an invader and prevent illness.

The victories over infectious diseases have been accompanied by a marked rise in the incidence of other diseases characterized by apparently spontaneous breakdowns of vital organs or by the malfunctioning of body processes. The increasing toll taken by heart disease and cancer are in part the inevitable outcome of the curing and prevention of infectious diseases, because many who in the past would have died of infections now live to suffer the breakdowns of middle and old age. But other factors, such as dietary habits, irritants in the atmosphere, smoking, emotional stress, and conditions consequent upon the elimination of infections also are being investigated as possible contributors to the increased prevalence of diseases classed as degenerative.

The success of “crash programs” of scientific research in speeding major discoveries—most dramatically demonstrated in the case of wartime atomic research—leads many persons to ask whether similar concentration on the study of specific diseases might not prove equally successful. When the National Foundation for Infantile Paralysis was organized in 1938, polio was a baffling disease; even the causative factor was undetermined. By early 1953, when the effectiveness of the Salk vaccine was indicated and mass testing

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was being planned, the Foundation had put \$18 million into the search for a preventive.¹

Difficult as was the polio problem, it did not present complexities comparable to those of the degenerative diseases. With the infectious group, the essential problem is to isolate the responsible organism (or organisms) and develop safe counteragents to destroy it. But no such isolation of causative factors can be anticipated in the case of organic or functional breakdown. To attain better control of the degenerative diseases, science must probe more deeply into the mysteries of the life process itself.

INCIDENCE AND TOLL OF DEGENERATIVE DISEASES

More than one-half of all deaths in the United States last year—780,000 out of 1,470,000—were caused by cardiovascular diseases. Approximately three-fourths of those who died of some heart affliction had suffered from a disease of the arteries which deprives the heart muscle of its blood supply, causes a part of the muscle to cease functioning, and encourages formation of blood clots that are frequently fatal. Most of the remaining victims of heart failure had hypertension (high blood pressure) or the rheumatic heart disease that often follows attacks of rheumatic fever, or they had been born with defective hearts.

Although heart disease is regarded as an illness of old age, because it is responsible for more than one-half of the mortality among older people, it frequently strikes young persons in one form or another. It is the leading cause of death among children and accounts for one-sixth of the deaths among persons between 20 and 40 years of age and for one-third of those occurring from age 35 to 55.² The U. S. Public Health Service estimates that ten million persons in the United States have some form of heart disease. In the war years, 1942-45, 80,000 servicemen died or were discharged for disability because of heart trouble. Compensation and pension payments to veterans with cardiac disability run around \$170 million a year, and an estimated

¹ Mike Gorman, executive secretary of the National Mental Health Committee, called on May 17 for research funds for mental disease comparable to those that have been available to battle polio. Testifying before the Senate Appropriations health subcommittee, Gorman pointed out that polio was "insignificant in incidence" as against mental illness—38,000 polio cases last year in contrast to "250,000 new cases of mental illness each year." Mental diseases are not generally classed as degenerative diseases. See "Mental Health Programs," *E.R.R.*, Vol. I 1954, pp. 305-322.

² The U. S. Children's Bureau estimates that 675,000 American children have had rheumatic fever; 1,500 persons under the age of 25 died in 1953 from that disease or its complications.

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653,000 man-years are lost to industry annually from this cause.

The second leading cause of death in the United States is cancer. The Public Health Service estimates that approximately 235,000 persons will die of cancer this year and that 650,000 will be under treatment; two-thirds of the latter number will be newly diagnosed cases. Around one-half of all cancer patients are between the ages of 50 and 70 years, but 15 per cent of cancer deaths occur among individuals under 45 years of age. One estimate places the productivity loss from cancer at \$12 billion a year. Three out of four diagnosed cases must be hospitalized, and one-fourth of the hospitalized patients require some assistance from charitable organizations to pay medical and hospital costs, which average \$885 per patient.

Another prevalent and baffling group of diseases includes the metabolic disorders, such as diabetes, cirrhosis of the liver, peptic ulcer, and the anemias, in which there is a defect or deficiency in the complex biochemical processes of the body. Some 50,000 persons a year die of diabetes or its complications. An estimated two million Americans have the disease, including some who are not aware of the condition. The long-term incidence is increasing, in part because many lives are spared by insulin treatment.

Approximately 20 million persons in the United States are affected to some extent by neurological or sensory disorders, which appear in around 200 different forms. Most familiar of this group are cerebral palsy, a brain damage affliction suffered by 240,000 children; epilepsy, with more than one million victims; multiple sclerosis, a progressively disabling disease which most frequently strikes between the ages of 20 and 40; cerebral vascular disease, and various afflictions affecting vision such as glaucoma and cataract. Most such disorders are incurable, only a few may be treated successfully, and fully ten million persons are gravely crippled by them.

Of major significance as disablers are the rheumatic diseases, which cause pain and stiffness in the joints and sometimes produce swelling, inflammation, and the growth of nodules which severely limit use of the limbs. More than ten million Americans sustain some degree of rheumatic affliction and one million are permanently disabled. Rheumatoid arthritis, known as "the great crippler," accounts

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more than any other disease for disability among those in the wage-earning years.

CHANGES IN U. S. DEATH RATE AND CAUSES OF DEATH

A drop in the United States death rate from 17 per 1,000 of the population in 1900 to 9.2 per 1,000 in 1954—the lowest on record—was brought about almost entirely by reducing the incidence and fatal outcome of infectious diseases and by lowering infant and maternal mortality. In 1900 the death rate from all infectious diseases combined was one-third higher than that for non-infectious breakdowns. Today there are 12 times as many fatalities from heart disease and cancer as there are from acute illnesses caused by infections.³

However, even in 1900 diseases of the cardiovascular system far outstripped all other single afflictions as a cause of death. Although infectious diseases as a group caused 676 deaths per 100,000 of the population, compared with 415 from chronic non-infectious diseases, afflictions of the cardiovascular system alone were responsible for 264 deaths per 100,000, or 62 more per 100,000 than were caused by influenza-pneumonia, then the second-ranking cause of death.

The death rate for cardiovascular diseases has risen 90 per cent since 1900, and the rate for cancer has fully doubled. Although inadequate diagnosis may have accounted in part for the relatively low mortality recorded for these ailments a half century ago, vital statistics of recent years indicate a true rise in incidence. The cardiovascular death rate increased from 452.8 per 100,000 of the population in 1940 to an all-time peak of 501 in 1953. Although the rate dropped back to 478 per 100,000 in 1954, it remains to be seen whether last year's improvement represents a permanent gain. The cancer death rate showed a consistent upward trend from 120.8 per 100,000 in 1940 to 147.7 in 1954.

CONTINUED VIGILANCE OVER COMMUNICABLE DISEASES

The great achievements in mastering infectious diseases by no means constitute total victory. Not only do certain infections continue to take a serious toll, but constant vigilance must be maintained to prevent a resurgence of others

³ Some of the important child-killing diseases of 50 years ago are now statistically negligible. Whooping cough, diphtheria, and measles together caused 65 fatalities per 100,000 of the population in 1900, but the 1953 rate was only 0.5 per 100,000, or two deaths for every 100,000 children under the age of 15.

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long quiescent. Communicable diseases in the United States still account for 100,000 deaths a year, or one of every four fatalities in the population under the age of 35. The very infrequency of certain infectious diseases tends to lower the population's resistance and to hamper speedy diagnosis when outbreaks do occur. An Ohio River community with 9,500 inhabitants last November experienced 35 cases of diphtheria, four of which resulted in death. A similar siege occurred early last year in a community in the Rocky Mountains.

Tuberculosis, which took an estimated 194.4 lives per 100,000 of the population in 1900, claimed only 10.6 per 100,000 in 1954, but 100,000 new cases were reported and another 50,000 relapsed cases were hospitalized last year. Although tuberculosis responds well to modern therapy,⁴ flare-ups may occur among the 1.2 million persons in whom the disease has been active in the past.

Venereal diseases, which had waned under the impact of intensive public health campaigns in the 1940s, are on the rise again;⁵ some 47,000 new cases of syphilis and one million cases of gonorrhea are recorded each year. Although venereal diseases are now relatively easy to cure, medical authorities cannot break the chain of infection and re-infection, nor has an effective immunization agent yet been developed.

Other infectious diseases appear to be increasing. Reported cases of hepatitis, caused by a virus, increased from 17,400 in 1952 to 60,000 in 1954, and officials estimate that reported cases constitute only one-tenth of the total incidence. There is no known remedy for hepatitis, and former victims may be carriers of the infection to others. Rabies is spreading in urban areas; of the half million dog bites a year, 50,000 require the painful, expensive, and sometimes dangerous Pasteur treatment. Diarrhea still kills 6,000 children under the age of two every year. Encephalitis, infectious mononucleosis, and psittacosis still are public health problems. Influenza and pneumonia, less feared because of effective treatment with antibiotics, nevertheless accounted last year for 25 deaths per 100,000 of the population; no preventive vaccine is in sight.

⁴ Effective treatment of tuberculosis today includes use of new surgical techniques and administration of new drugs, particularly streptomycin, isoniazid, and PAS (para-amino salicylic acid).

⁵ Thirty-six states reported increases in venereal diseases in the last six months of 1954.

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GROWTH AND CURRENT TRENDS OF MEDICAL RESEARCH

The shift in importance of the various diseases as predominant causes of death and disability has brought about a marked change in orientation of medical research. Dr. William H. Sebrell, Jr., director of the National Institutes of Health, recently observed that "Research today is becoming increasingly complex and varied, increasingly dependent upon new techniques and facilities and disciplines, as medical science probes deeper and deeper into the secrets of life itself in order to understand the chronic and degenerative diseases which have emerged as our major health problems."⁶

While the search continues for more and better immunizing agents against infection, there is increasing integration of medical research on all types of disease. A major effort is being made to unlock the basic secrets of biochemical synthesis, which will open up larger understanding of all normal and abnormal body processes under both infected and non-infected conditions. As knowledge grows, the interrelation of various diseases and their common link with biochemical processes become apparent. Many new discoveries have proved useful in treating several types of disease.

Medical research is becoming increasingly dependent on advances in other scientific fields. Atomic research for military objectives produced major new techniques for the study and treatment of cancer. Much medical research has grown out of advances in the science of instrumentation.

So many varied skills are now required in the study of disease that the lone scientist in his laboratory is no longer the typical agent of important discovery. Sebrell has noted that the increasing size and diversity of the effective research group require more formal organization than used to be the case. He has warned that "the process of organization [must] be handled so that it contributes to, rather than detracts from, the scientific product."

Public health measures of the past were concerned primarily with preventing transmission of communicable diseases, and they were easily justified as necessary to protect the public against epidemics. Today there is growing acceptance of the principle that the community must be protected also against the tremendous social cost of widespread chronic disease. This philosophy is at the base of a

⁶ Address, University of Minnesota Medical School, Minneapolis, Oct. 22, 1954.

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tremendous increase over the postwar period in public support of medical research and of assistance to those who are chronically ill.

Advances in Control of Major Diseases

KNOWLEDGE gained from recent medical research as yet has produced few true preventives or cures for degenerative diseases, but valuable new methods of treatment are prolonging life and permitting many disabled individuals to resume normal activities. Although medical science can offer slight immunity against serious breakdowns in the human system, in many instances it can halt the progress of disease if the abnormalities are detected at an early stage.

For this reason, public health authorities in recent years have placed great emphasis on developing procedures for examining large numbers of persons quickly and inexpensively. Such efforts have produced the so-called multiple screen method, described by a public health official as "the application of a battery of economical, rapidly applied tests to screen out apparently well persons who probably have a disease from those who probably do not." This technique is particularly important because a degenerative disease frequently will develop to the danger point before the individual is aware that there is anything wrong with him.

EFFORTS TO DEVELOP SAFEGUARDS AGAINST CANCER

The advantages of early diagnosis of cancer have long been recognized. The need to convince the public of the importance of prompt detection was one of the major reasons for forming the American Cancer Society in 1913. It has been stated that one-half of all cancer cases today could be treated successfully if brought to the attention of a competent physician in time; actually only about one-half of the curable cancers are detected before they become hopeless. The cure rate of early uterine cancer is 95 per cent. Cancer of the breast, if confined to that area, can be cured seven times out of ten. Cancer of the mouth is curable in 75 per cent of the cases if the affected area is no larger than a dime. However, the actual cure rate of these prevalent forms of cancer falls considerably short of the potential rate.

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Two years ago the U. S. Public Health Service, in cooperation with state and local agencies, conducted a "cytology screen project" in the Memphis-Shelby County, Tenn., area to demonstrate the feasibility of mass check-ups for uterine cancer. Of 70,000 women examined by a simple, inexpensive mass examination process, 2 per cent showed suspicious symptoms and one-half of the women having those symptoms were proved by additional laboratory tests to be suffering from the disease. Of those with cancer of the uterus, 60 per cent had experienced no symptoms; of those with cervical cancer, which is considered an early stage of the disease, 90 per cent had no awareness of abnormality before the biopsy was taken. Dr. John R. Heller, director of the National Cancer Institute, concluded from the demonstration that "If the [cytology screen] technique is applied generally on a mass basis, it should be possible to obliterate or greatly reduce . . . the second most prevalent type of cancer in women."

A new instrument, the somascope, utilizes sonar and radar techniques to permit more accurate location of tumors inside the body. Research is going forward also on development of a method for large-scale automatic screening for cancer by electrical measurement of the bright fluorescence shown by cancer cells under ultraviolet light. Other studies look to a variety of blood tests to determine the presence of early cancer.

Discoveries of environmental and occupational sources of cancer have led to measures for protecting individuals against exposure to certain materials that incite growth of cancer cells. Further advances in cancer prevention may develop from current studies of the correlation between cancer incidence and geographical location, race, and sex. The National Cancer Institute recently completed a tabulation of such data for ten metropolitan areas that may cast light on this subject.⁷ Both the National Institute and the American Cancer Society are surveying the smoking habits of men over 50 in an effort to establish definitely whether there is any connection between smoking and lung cancer. A Tobacco Industry Research Committee also is sponsoring extensive scientific research on this question.

Cancer is essentially a disease of the individual cell and the only cure is to remove the cancerous tissue either by

⁷ The study showed, for instance, that among the white population cancer is more prevalent in the South and West than in the North, and that the overall death rate is higher for men than for women.

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surgery or by irradiation with X-ray or radium. Such measures are effective only when the cancer cells are localized. If the disease is disseminated through the body, its complete eradication is unlikely.

PROGRESS IN TREATING CANCER; USE OF NEW DRUGS

Techniques in surgery and irradiation have been greatly improved within the past few years. In addition, a number of drugs have come into use which, while not curative, greatly enhance the effectiveness of removal techniques. Drugs are useful also in prolonging life and reducing the suffering of victims of incurable cancer. Drugs now used in treating cancer include hormones, nitrogen mustard, and a group known as folic acid antagonists. Among the many forms of cancer which now yield in part to drug therapy are leukemia, Hodgkins' disease, lung and brain tumors, and advanced cancers of the breast, prostate gland, and bladder.

Until 1947, children stricken with acute leukemia, a swiftly progressing disease that affects the production of white blood cells, could expect to live only a few weeks or months. Chemotherapy has greatly extended their life span and kept alive hope that a more permanent palliative may be found. According to a February 1955 progress report of the National Cancer Institute, one-half of a group of 300 child sufferers from acute leukemia who received the anti-folic treatment at Children's Medical Center in Boston had survived more than 11 months; 10 per cent were alive after 19 months; one child was in excellent health 52 months after diagnosis. A new chemical, 6-mercaptopurine, temporarily halted leukemia in another group of children at Memorial Cancer Center, New York, after all other treatment had failed.

Until recently surgery and irradiation were limited by secondary problems, such as the risk of infection, hemorrhage, shock, and anemia. Now a much bolder attack on the cancer area can be sustained by use of antibiotics, improved anesthesia, and devices for controlling the loss of blood. On the whole, more persons each year survive cancer surgery, and a growing number of the survivors appear to be free of the disease for several years after surgery.

Advances in physics and engineering have greatly enhanced the effectiveness of cancer therapy. Use of super-powered X-ray generators permits stronger attack on deep-

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seated tumors that cannot be reached by surgery. A new technique by which the patient is placed in a rotating chair underneath an X-ray beam makes it possible to pinpoint radiation on the cancer area with a minimum of harm to neighboring tissue. Radioactive iodine has proved valuable against cancer of the thyroid; radioactive phosphorous is useful against chronic leukemia; and other radioactive substances help to locate brain tumors so they may be removed with greater precision than formerly.

NEW APPROACHES TO TREATMENT OF HEART DISEASE

Success in dealing with certain types of heart disease has reduced them to relatively minor health problems. Once prevalent heart ailments resulting from syphilitic infection, hyperthyroidism, and various bacterial infections are now preventable or curable. Congenital heart disease, which used to be considered hopeless, today can often be surgically corrected and in some cases prevented by proper pre-natal care of the mother.

Thousands of operations on at least six different types of heart malformations have been successfully performed in recent years. Holes in the partition which separates the two sides of the heart can now be sealed; blood vessels and lengths of artery can be grafted; and valve openings can be widened or tightened. "Deep freeze" methods of surgery permit more meticulous repair of heart defects. Operations once thought futile are now being performed with the aid of a new technique that links the circulatory system of the patient to that of a blood donor; the technique permits the blood flow through the patient's heart to be clamped off and surgery performed in a blood-free area. A new method of entering the left side of the heart by way of the windpipe provides safe approach to an area difficult to reach.

Rheumatic heart disease can now be prevented by prompt treatment of streptococcal infections, which almost always precede an attack, and by continuing to administer penicillin or sulfadiazine regularly to prevent recurrence. Meanwhile, many whose heart valves have been damaged by rheumatic fever are being helped by new surgical methods. Twenty-four patients now are living with a plastic ball in place of the aortic valve, which prevents the backflow of blood into the heart.

Several new drugs are effective in treatment of high blood pressure. Reserpine, derived from the Indian snakewood

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plant (*Rauwolfia Serpentina*) is in wide use today; it appears to enhance the potency of other drugs while diminishing unfavorable side-effects. Several other drugs were successfully tested on patients last year. One of them, known as Su-3088, was administered to a group of 15 patients; one small pill before breakfast reduced their blood pressure to normal for the rest of the day.

The most prevalent form of heart disease and the one which causes the characteristic "heart attack" is atherosclerosis, which is characterized by a thickening of the artery wall due to deposits of a fatty substance called cholesterol. The condition is difficult to diagnose until after the flow of blood has been drastically restricted and the heart muscle damaged. Current research is aimed at discovering methods of earlier diagnosis so that preventive measures may be taken before serious damage to the heart occurs.

No available specific will reverse the arterial changes in human subjects, but doctors have learned a great deal about coping with the acute phase of the disease. Use of anti-coagulants restrains the spread of blood clots, and procainamide, a new drug, limits dangerous irregularities of the heart. According to Dr. James A. Shannon, associate director of the National Institutes of Health, these drugs have cut fatalities in acute attacks by 50 per cent. Low fat diets also are prescribed, because the disease appears to be associated with the accumulation of fatty substances in the blood and because mortality is higher among the obese.

ALLEVIATION OF ARTHRITIS AND OTHER CHRONIC ILLS

The director of the National Institute of Arthritis and Metabolic Diseases recently observed that more progress had been made in control of that large group of ills in the past five years than in the previous 500 years.⁸ As with most degenerative diseases, arthritis is best treated at an early stage before the crippling condition is firmly established. The National Institute is developing a relatively simple blood test that eventually may become a major instrument in reducing the seriousness of the disease.

Cortisone, hydrocortisone, and ACTH are widely used on patients with arthritis; these drugs reduce the inflammation markedly. However, prolonged medication has undesirable side-effects, and discontinuation of the treatment brings re-

⁸ Dr. Floyd S. Daft, testimony before House Appropriations subcommittee, Feb. 14, 1955.

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lapse in four-fifths of the cases. Two drugs that were tested on patients at the National Institute for the first time last year—metacortandralone and metacortandracin—showed “prompt, positive, and consistent results.” Investigators believe that those drugs are four times as potent as cortisone and have fewer unfavorable secondary effects.

A recent discovery—that epileptics appear to suffer an inability to maintain glutamic acid at normal levels within the brain cells—led to an intensified search for substances to compensate for that defect. Congress in June 1954 appropriated \$750,000 for the study of two related materials, glutamine and asparagine, that might serve the purpose. A recent report on tests of the drugs on 14 epileptics at the Institute showed that three had become seizure-free, nine had experienced a 60 per cent reduction in attacks, and two had had “equivocal responses.”

A clinical study at the Institute definitely established that retrorenal fibroplasia, a common cause of blindness occurring chiefly in premature infants, was caused by oxygen routinely administered to undersized babies in incubators. This tragic affliction, which has blinded 8,000 American children, now has been virtually eliminated. The Institute reported also that a new drug, diamox, is used successfully as a specific for acute glaucoma.

Research on crippling neurological diseases such as cerebral palsy, muscular dystrophy, and multiple sclerosis has been going on for too short a time to produce dramatic results in terms of prevention or treatment. Better understanding of these afflictions, however, is developing, and new techniques are helping to alleviate some of the symptoms. The National Institutes of Health recently reported, for example, that it had developed a surgical refinement for relieving the severe involuntary movements of spastics.

Outlook for Conquest of Killer Diseases

THE SURGEON GENERAL of the U. S. Public Health Service, Dr. Leonard A. Scheele, recently remarked that the unparalleled support of medical research over the past decade was “yielding new knowledge that will be as effective against our major health problems of today as earlier

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research accomplishments were against insanitary conditions and epidemic diseases of the past." In no other decade of history has so much new understanding of disease been gained.

The postwar period was marked by development at Bethesda, Md., near Washington, of a vast federal research establishment for the study of disease, and by expansion of the activities of national organizations that raise large sums for medical research from voluntary contributions. It is difficult to ascertain the total amount of money currently going into medical research. Considerable study is carried on in connection with the routine programs of universities, hospitals, research laboratories, and commercial drug manufacturers. In addition, scientific investigation in non-medical fields often produces results of great value to medical practice or supplies aids to more effective research.

Aside from such activities, at least a half billion dollars in public and private funds was awarded over the period 1946-1954 in the form of special grants for research in medical fields. Annual totals for this purpose have risen from less than \$5 million in the year ended June 30, 1946, to \$67 million in fiscal 1954.⁹

RISE OF FEDERAL SUPPORT FOR MEDICAL RESEARCH

The growth of tax-supported medical research dates primarily from 1944, when Congress reorganized the U. S. Public Health Service and elevated the National Institute of Health (now the National Institutes of Health) to become one of the major branches of the service.¹⁰ At that time only one unit of the National Institute was devoted to the study of a single disease: the National Cancer Institute. Research in other diseases was incorporated in the programs of the divisions of physiology and of the chemistry, pathology, and physical biology laboratories. Since then, separate institutes have been established in the fields of arthritis and metabolic diseases, dentistry, heart disease, mental health, microbiology, and neurological diseases and blindness.

⁹ Bio-Sciences Information Exchange, Smithsonian Institution, Washington, D. C. The totals represent research grant funds awarded by the federal government, national voluntary organizations, and private foundations. They do not include total costs of research to the institutions where studies are conducted, funds for care of patients, grants for fellowships, disease control programs, construction of facilities, or local and minor grants for medical research.

¹⁰ The government's largest medical research establishment had its origin in the Hygienic Laboratory, set up in August 1887 as an adjunct of the Marine Hospital on Staten Island, N. Y., to undertake studies of cholera, yellow fever, and bubonic plague among merchant seamen and immigrants. The Hygienic Laboratory became the National Institute of Health in 1930.

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The Institutes of Health not only constitutes in itself a major network of research; it also administers federal grants for research, fellowships, and medical training at other establishments; and it serves as a center for coordinated planning of all medical research through its close relationships with other agencies concerned with the conquest of disease. One-fourth of all research at the nation's medical schools is supported by more than 3,000 Public Health grants; additional funds from this source are subsidizing the education of 400 fellows and 1,100 trainees who plan careers in research and medical practice.

Important medical studies are conducted or authorized also by other federal agencies, chiefly the Atomic Energy Commission, the Departments of the Air Force, Army, and Navy, the National Science Foundation, and the Veterans Administration. An official survey of governmental research expenditures shows that the various federal agencies have obligated themselves during the year ending June 30, 1955, for approximately \$168.4 million for research and development in the medical and biological sciences.¹¹ This amount represents an increase of approximately \$20 million over the total for the fiscal year ended June 30, 1953.

Specific grants by federal agencies for medical research projects in either governmental or private establishments totaled \$50.3 million in the fiscal year ended June 30, 1954, according to the Bio-Sciences Information Exchange. That sum was \$10 million more than what had been granted for the purpose in the fiscal year 1953, and 150 per cent more than the total of special grants in fiscal 1950. In 1946 such grants amounted to only \$1,871,000.

GROWTH OF FUND-RAISING FOR PARTICULAR DISEASES

The postwar decade has witnessed a phenomenal growth in the fund-raising activities of voluntary organizations devoted to the conquest of specific diseases. Several of these groups, functioning for years on a small scale as professional associations, were reorganized after the war to include lay members and broaden public interest.

The American Cancer Society was thus reorganized in

¹¹ National Science Foundation, *Federal Funds for Science, III. The Federal Research and Development Budget, Fiscal Years 1953, 1954, and 1955*. The amount cited includes "all indirect, incidental or related costs resulting from or necessary to the conduct of such research and development . . . [but] excludes routine testing, mapping and surveys, experimental production and activities concerned primarily with dissemination of scientific information or the training of scientific manpower."

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1945, and its receipts from voluntary contributions, which had amounted to only \$1 million in 1944, rose to \$21.7 million in 1954.¹² The American Heart Association, formed in 1924 by a group of doctors, was reorganized in the same manner a half dozen years ago, and the fund it raises in annual drives increased from \$2.7 million in 1949 to \$11 million in the current fiscal year.

Similar organizations have been formed to raise funds for other areas of medical need. The National Multiple Sclerosis Society was created in 1946, the Arthritis and Rheumatism Foundation in 1948, and the United Cerebral Palsy Associations in 1949. A number of such organizations recently joined to form the National Committee for Research in Neurological Disorders to stimulate public support for study of the many diseases affecting the nerve system.

A tabulation by the Bio-Sciences Information Exchange shows that the amount of special research grants awarded by such private agencies and by the philanthropic foundations rose from \$2,436,000 in 1946 to \$16,566,000 in 1954. Contributions of the private organizations to the conquest of disease are not measured entirely in terms of research grants. The voluntary health organizations are given credit for creating a public opinion favorable to generous tax support of medical research.

A large part of the funds collected by the organizations is used to educate the public on the need to seek early diagnosis of disease. The national associations and their local chapters also participate in various disease control programs, help to disseminate new research findings, subsidize fellowships, contribute to the care and rehabilitation of patients, and assist local medical institutions.

PRESENT STRESS ON STUDY OF METABOLIC DISORDERS

Cancer was the first of the degenerative diseases to attract widespread public interest, and it continues to receive a relatively large share of the medical research dollar. Allocations to cancer research have been substantial, for one reason, because the disease arises from a disturbance in the fundamental component of living tissue—the cell—and studies in a number of different fields have important bearing on the search for the basic cause of cancer.

Tabulations of research grants by the Bio-Sciences In-

¹² The American Cancer Society's goal for 1955 is \$25 million.

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formation Exchange indicate that amounts granted from public and private funds for special studies in the field of cancer rose from \$600,000 in fiscal 1946 to nearly \$7 million in 1950 and to \$12.2 million in 1954. Research pertaining to heart disease received only \$270,000 in 1946, but the amount rose to \$5.2 million in 1950 and totaled nearly \$8.7 million in 1954.¹³

However, within the last few years, as noted, there has been a shift of emphasis in medical research to fields where basic secrets of the life process may be revealed. In response to that trend, grants for research in metabolism and metabolic diseases rose from \$3.8 million in 1950 to nearly \$14.5 million in 1954; grants for studies of the endocrine system and of the nervous system more than doubled in the same period to approximately \$8 million each in 1954, while amounts for research on the musculoskeletal system rose from approximately \$3 million to nearly \$5 million. These major increases were brought about largely by federal government appropriations for study of the diseases at the National Institutes of Health. According to Dr. Floyd S. Daft, director of the National Institute of Arthritis and Metabolic Diseases, the areas of research involved "impinge on virtually every disease of man."

Although most research money is granted for the pursuit of practical solutions to medical problems, such as the testing of effective drugs for particular conditions, there is growing emphasis on the need for more pure research that may yield fuller comprehension of biologic phenomena without regard to a particular medical situation. The National Science Foundation's tally of federal research expenditures shows that five times as much is being spent for applied as for basic research in the medical and biologic sciences.

Dr. Sebrell has pointed out that discoveries in basic research may be "less dramatic in terms of clinical application" but "perhaps even more important to ultimate progress against disease," because they provide "the solid base upon which clinical advances rest." The National Institutes of Health receives annually a special appropriation, amounting to nearly \$5 million in the current fiscal year, for research grants outside the confines of a particular disease group. Many projects for the pursuit of pure knowledge are financed from this fund. In addition, grantees in most

¹³Totals for research grants in the various areas of disease involve some overlapping, because certain study projects may have a bearing on more than one group of diseases.

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areas of medical research under the federal program are given freedom to deviate from the assigned goals if promising leads develop in other directions.¹⁴

MAJOR NEW LEADS TO FUTURE TRIUMPHS OVER DISEASE

Significant discoveries in medical research are not necessarily those which become immediately applicable to relief of disease sufferers. On the contrary, they may be the discoveries that illuminate new areas of basic knowledge, improve the techniques of research itself, or offer promising avenues for future study. Various developments of this sort within the past year may lead to fundamental changes in the medical approach to degenerative diseases by turning it from attempts to control symptoms and halt the progress of a disease to efforts to prevent the disease or eliminate its cause.

Major research at the National Cancer Institute is concerned with the chemistry and biology of growth itself because, in the opinion of Institute scientists, discoveries in that field will provide a "more rational approach to the cancer problem than is now possible." Scientists are making intensive studies of pre-natal life for a better understanding of the growth process and the relationship between the mother's state of health and the development of the unborn child. New techniques for direct observation of foetal growth in the very earliest stages have been developed within the past few years.

Because biochemistry is basic to the study of almost all diseases, considerable research is being carried on in that subject. Development of improved methods for separating, purifying, and synthesizing protein components, which are essential to life, may hold the key to major clinical techniques of the future. Endocrinology is another field in which enlargement of pure knowledge may affect the future treatment of numerous diseases. Investigations are opening up new facets in the relationship between the brain and the pituitary gland in the control of tissue growth. The recent feat of maintaining human adrenal glands outside the body in a living state long enough to isolate at least 17 different substances for further study was an accomplishment of major importance.

¹⁴ The scientific world is impressed by the fact that many major discoveries in medical science were made because the scientist was free to satisfy his curiosity about phenomena not related to his immediate project. The most notable instance of recent times was Sir Alexander Fleming's discovery of penicillin when he digressed from the work he was doing to observe the action of a stray mold spore on a microbe culture.

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Of interest to cancer patients is the fact that experiments have shown that cancer cells may be selectively starved or poisoned if the right drug or drugs can be found. Methods have been developed for transplanting and growing human tumors on laboratory animals, on fertilized eggs, and in the test tube. Biologists thus are enabled to study how cancer cells evolve from normal cells. Scientists are investigating the life span of the red blood cell in search of the connection between cancer and the characteristic anemia of cancer patients.

Hope for victims of coronary disease may result from intensive studies of the body's method of handling fat. Last year for the first time that process was recreated in the test tube; it permits more rapid and precise investigation of the means by which the fatty material, cholesterol, is broken down. Scientists are working on a "clearing factor," a substance which might be administered to patients to clear away the fatty deposits in the artery. Within recent months it has been proved that, at least in the laboratory, the process which causes most of the heart failures can be reversed.

Similar advances are being reported almost daily in many fields. Prospects for conquest of degenerative diseases are improved when the research effort is widespread and when laboratory findings may be quickly communicated to other research scientists and doctors. Dr. Sebrell, noting the passing of medical research leadership from Europe to the United States, has pointed to a need for "balance between support for general medical research and direct attack on specific disease problems." He has cautioned that "neither area should be advanced at the expense of the other."



